Project Title: Probing the reionization epoch with quasar absorption lines

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Project Description:

The epoch of reionization represents the last global change of phase underwent by our Universe. Determining when and how reionization happened is one of the key open questions for observational and theoretical cosmology and one of the key drivers for many of the major astronomical facilities foreseen in the next 10-15 years (e.g. the Extremely Large Telescope or the Square Kilometer Array).

We propose a PhD thesis on the investigation of the properties of the high-redshift inter and circum-galactic medium (IGM, CGM) to set constraints on the process of cosmological reionization and the nature of the first sources. The project will be based on the analysis of unique, state-of-the-art observational samples of quasar absorption spectra covering a redshift interval between 1.5 and 6.5 and the interpretation of the observables with state-of-the-art cosmological simulations.

The line of research proposed for this PhD thesis foresee the use of hydrogen and heavier element (dubbed metals) absorption lines observed at high redshift to derive constraints on the redshift evolution of: i) the neutral hydrogen fraction; ii) the IGM/CGM metal enrichment; iii) the shape and intensity of the UV background flux and as a consequence the nature of the ionizing sources.

Besides the research work, the PhD fellow will have the opportunity to acquire several useful skills ranging from the use of software tools for the data reduction and analysis to the writing of proposals for the main telescopes in the world. Furthermore,

she/he will carry out the PhD project in the context of the international collaboration involved in the exploitation of the Xshooter Large Programme data (which also includes many researchers at OATs). The PhD fellow will also have the possibility to be involved in the design phase of the HIRES spectrograph for the European ELT starting in 2021.

References:

Becker et al. 2015, PASA 32, 45, arXiv:1510.03368
Dayal & Ferrara 2018, Phys. Rept., 780-782, 1, arXiv:1809.09136